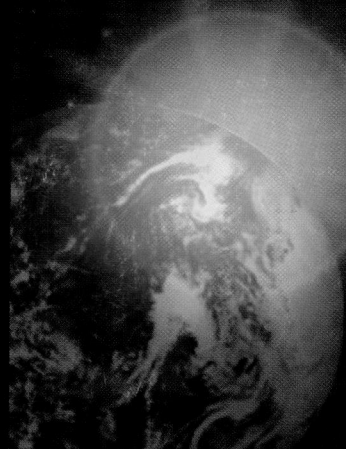


MDR TECHNOLOGIES INC.





MDR-2000

*User's Reference
Manual*

**MDR-2000 Intelligent Storage Unit
User's Reference Manual
(Major Release 3)**

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MDR-2000 V3 User's Reference Manual
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Notice

This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient or relocate the receiving antenna.
- Increase the separation between the equipment and receiver.
- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
- Consult the dealer or an experienced radio/TV technician for help.

Warning

Changes or modifications not expressly approved by MDR Technologies Inc. could void the user's authority to operate the equipment.

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Chapter 1

INTRODUCTION

This manual describes the operational characteristics of the MDR-2000 Intelligent Storage Unit. All aspects of the operational capability of the MDR-2000 are covered including details for unit setup, operation and trouble shooting.

Generally reference to this manual will only be required when programming applications software to interface with the MDR-2000. This information is provided in chapter 4. In addition, reference during field setup may be required to properly adjust the option settings. This information is found in chapters 3, 5, 6 and 7. Chapter 5 provides details on the Interactive Monitor used for remote setup of the unit. Chapter 6 provides details on troubleshooting and chapter 7 on the cabling conventions.

For information on sizing the MDR-2000 to meet anticipated storage requirements please refer to the document entitled 'MDR-2000 Data Collector Capacity Calculations'. Electrical, physical and environmental specifications are provided on the MDR-2000 Data Collector brochure. Both of these documents are available from MDR or your MDR Distributor.

Chapter 2

OVERVIEW

The purpose of this section is to provide a general description of the MDR-2000 Intelligent Storage Unit. Each of the features discussed in this section will be further described in later sections of the manual.

2.1 Description

The MDR-2000 is a compact, highly versatile data collection device. It is designed for maintenance free operation with reliability features to ensure data integrity and low support and service costs.

The MDR-2000 can be installed quickly. It requires a minimum of space and has no environmental requirements other than those normally found in the office or equipment room.

Once in operation the MDR-2000 will collect call detail record (CDR) data and optionally image data from the PBX for later transmission and downstream processing. As part of the data collection process, the MDR-2000 formats the call detail records into an Expanded MDR Standard Record format. The use of the Expanded MDR Standard Record format means that records collected from different types of PBXs are presented in a consistent format to simplify downstream processing.

As part of the formatting process, call records can be retained or discarded based on the number of digits dialed, the duration of the call, and whether it is incoming or internal. This feature facilitates discarding of incomplete calls and local calls. By varying these parameters fine tuning of the collected data is made possible. In addition, the MDR-2000 will deduct the duration selected from the time reported for each call. This feature assists downstream processing accuracy by eliminating circuit connection and ringing delays.

When collecting maintenance records the MDR-2000 can be set up to report alarms or error conditions. On these systems the MDR-2000 is used to record this information and optionally alert a downstream processing facility when preprogrammed alarms occur.

The MDR-2000 is microprocessor based. This approach provides flexibility in keeping the MDR-2000 current with PBX manufacturers' changing specifications. It also means reliability and maintainability. The MDR-2000 has diagnostic features to aid in problem determination. As well, keep-alive circuitry and battery backup are provided to ensure that the MDR-2000 keeps running during power failures.

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The MDR-2000 communicates with the PBX via an RS232-C compatible port. Communications with downstream processing facilities is made possible by using another RS232-C port via direct connection or modem. The MDR-2000 can be setup to communicate at speeds up to 19200 Baud, but is limited by the data capability of the downstream facilities to accept the data at the higher speeds, the modem equipment and the quality of the transmission lines.

To ensure data integrity, the data transmitted to the downstream processing unit is encapsulated in a data packet. The packet contains byte count and checksum information to provide error detection capability. If an error is detected by the software the MDR-2000 is requested to send the packet again. This feature is important in ensuring the integrity of the downstream report processing.

While the MDR-2000 is transferring data downstream it continues to collect and process information from the PBX. This facility means that prime-time data collection from the MDR-2000 is practical.

The unique design of the MDR-2000 incorporates the use of hardware and software to isolate internal data integrity violations. This means that the data stored in the MDR-2000 is interrogated upon transmission to downstream facilities to ensure that what was originally stored in the MDR-2000's large buffer memory is in fact unaltered when selected for transmission.

Commands by the downstream processing unit to the MDR-2000 or by technicians for remote diagnosis are very simple. Commands exist in two command structures, computer-to-computer and interactive.

By using groups of computer-to-computer commands the MDR-2000 will perform all of the functions necessary for automatic data collection. These commands provide the functionality listed below.

Communications Commands:

- o Send the current record or block of records to the downstream processing system.
- o Advance to the next record or block of records.
- o Clear all of the previously transmitted records. This command makes room for new records.
- o Reset to the beginning of the buffer. This command helps recover records lost due to downstream processing failures.
- o Doorbell. This command returns a simple 'Hello' response to ensure that a connection to the MDR-2000 has been made.

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- o Specify which type of records to transmit, CDR or Image records, or both.

Maintenance/Support Commands:

- o Pass data from the PBX to the communications port for dynamic monitoring of PBX activity. Data is still processed and retained by the MDR-2000.
- o Send a maintenance record consisting of pointer values, indicator LED values, serial number, and memory size over the communications port.
- o Send an ASCII test sequence over the communications port.
- o Commands to reset the MDR-2000's PBX port, the entire MDR-2000, or the MDR-2000 buffer memory.
- o Test commands to verify the integrity of stored data and check the RAM memories.
- o View the last record rejected by the MDR-2000.
- o Send an MDR-2000 identification message indicating the PBX type, MDR-2000 generic, and software revision and serial number.
- o Enter the Interactive Monitor (Described later in this document).

The interactive commands are provided by a software module called the Interactive Monitor. It provides most of the functionality described above but in a more humanly engineered format. Its purpose is for operational control of the unit. All options are set by the Interactive Monitor to provide complete control and configuration of the MDR-2000 remotely.

2.2 Feature Cross-Reference

The following table is a feature cross-reference for the more popular PBX and keysystems. It specifies the call record characteristics by PBX. The terms 'n/a' or 'No' in the table mean that the feature is not supported by the PBX or that the MDR-2000 does not currently support it (Usually due to a lack of information about the PBX data format).

There are many PBX and keysystems on the market sold under various brand names and features can vary by country, supplier and revision. The MDR-2000 is continually being revised and updated as new PBXs are supported and features of existing PBXs change. If the PBX or keysystem in question is not on this list, or you have questions about the information in the table, please contact MDR for the latest available status.

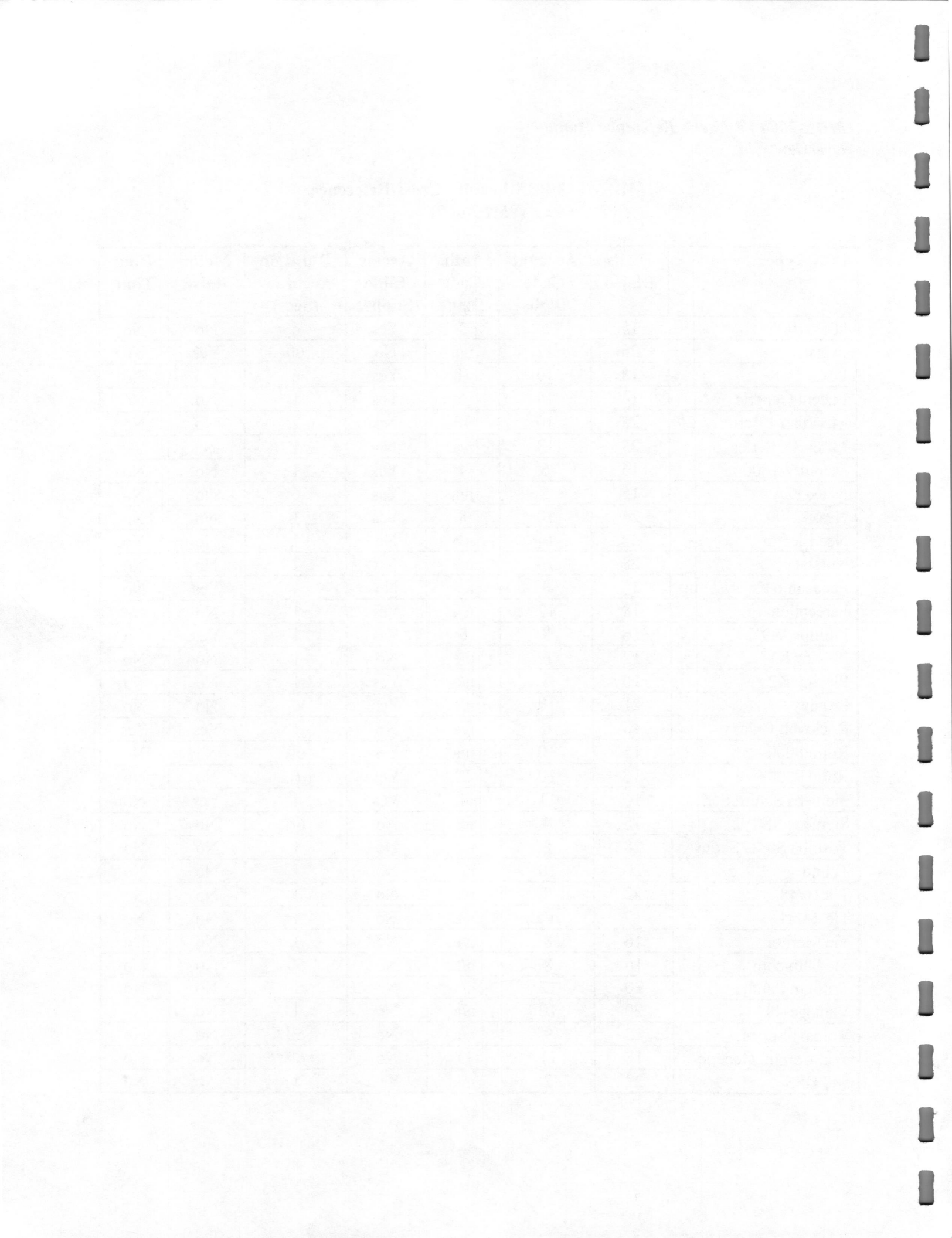
MDR-2000/PBX Feature Cross-Reference
(Part 1 of 2)

PBX Type	Digits Dialed	Account Code Digits	Auth. Code Digits	Access Code Suppr.	Duration Accuracy (Secs)	Meter Pulse	Ring Time
Amtelco Generic	16	8	8	Yes	6	No	No
AT&T Legend/Merlin	18	n/a	16	No	1	No	No
AT&T 75	15	5	7	Yes	6	No	No
CBX-I/CBX-II	See Rolm-8000/Rolm-9000						
Citation	28	8	n/a	No	1	No	No
Dimension FP Series	18	5	7	Yes	6	No	No
Ericsson MD110	20	15	6	Yes	6	Yes	Yes
Focus II/III	20	15	n/a	Yes	1	No	No
Fujitsu 9600	25	15	6	Yes	1	Yes	No
Fujitsu Starlog	20	15	n/a	Yes	1	No	No
GTD-1000	20	8	n/a	No	1	No	No
GTD Omni	20	11	n/a	No	60	No	No
Hitachi EX-10	15	n/a	n/a	Yes	6	No	No
IDS-128	26	6	n/a	No	60	No	No
InterTel 32/128	24	8	n/a	No	60	No	No
iSDX V2.x Series	18	8	n/a	Yes	1	Yes	Yes
Isotech 36	20	10	n/a	No	1	No	No

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MDR-2000/PBX Feature Cross-Reference
(Part 2 of 2)

PBX Type	Digits Dialed	Account Code Digits	Auth. Code Digits	Access Code Suppr.	Duration Accuracy (Secs)	Meter Pulse	Ring Time
ITT 3100L	15	5	7	Yes	6	No	No
Iwatsu	26	12	n/a	No	60	Yes	No
Lexar	18	10	10	Yes	6	No	No
Lucent Generic	14	14	6	Yes	1	No	No
Meridian 1 Series	28	10	10	No	2	No	No
Mitel SX Series	23	12	n/a	No	1	Yes	Yes
Mercury-1000	16	6	4	Yes	1	No	No
Neax-12A	15	5	n/a	Yes	6	No	No
Neax-2400	24	10	8	Yes	1	No	No
Nec Electra	22	14	n/a	No	1	No	No
Norstar	28	10	n/a	No	2	No	No
Panasonic KeySystems	36	8	n/a	No	1	Yes	No
Perception	18	12	n/a	Yes	1	No	No
Phillips VOX	16	8	6	Yes	1	Yes	No
Plessey K1	12	6	n/a	No	1	No	No
Plessey K2	16	6	n/a	Yes	1	No	No
Prodigy	21	10	n/a	Yes	6	No	No
Rockwell Galaxy	16	6	n/a	No	1	Yes	Yes
Rolm 8000	15	10	n/a	Yes	60	No	No
Rolm 9000	16	10	12	Yes	6	No	No
Siemens Saturn Series	16	11	4	Yes	1	Yes	No
Siemens SD192	15	4	n/a	No	60	No	No
Toshiba Strata Series	28	8	n/a	No	1	No	No
Telrad	20	10	n/a	No	1	No	No
Tie 16/48	22	9	n/a	No	1	No	No
Tie 24/64	19	n/a	n/a	No	1	No	No
Tie Meritor	16	8	n/a	No	1	No	No
Tie Ultracom	16	8	n/a	No	60	No	No
Trillium Panther	20	12	n/a	No	1	No	No
Vantage-48	20	10	n/a	No	1	No	No
Voldavi Series	22	9	n/a	No	60	No	No
Win Comm. Generic	18	11	11	No	60	No	No
580 DSS	22	7	n/a	Yes	1	No	No



Chapter 3

DATA COLLECTION

The purpose of this section is to describe the data collection process as well as the contents and format of the data used by the MDR-2000.

3.1 CDR Data Collection

This section describes the details of call detail record collection on the MDR-2000. It covers the conversion of PBX CDR records to Expanded MDR Standard Format, the available data selection options, and the data translation defaults that are used.

Information on the Expanded MDR Standard Format is provided to assist in downstream processing applications.

All data is collected from the PBXs over a 300 to 19200 Baud, RS232-C compatible port. This is generally achieved by requesting the PBX supplier to enable the port on the PBX. In general, the PBX CDR port must be configured for a standalone hardcopy terminal. That is how the MDR-2000 looks to the PBX.

3.1.1 Input/Output Records

A variety of PBXs are supported by the MDR-2000 and new ones are added to the list as required. Each individual PBX requires a custom ROM (Read-Only Memory) chip for that PBX generic. The differences that exist between ROM versions is entirely limited to the translation software. The translation software is that component of the MDR-2000 that converts PBX specific data into the Expanded MDR Standard Format CDR records.

Each record sent from the PBX is terminated by, or preceded by, a carriage-return/linefeed pair, and one or more of the following characters; NUL, DEL, DC1, DC2, or DC3. These special characters are ignored, the carriage-return is required.

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The following information must be output by the PBX in order for it to be a suitable device for MDR-2000 and downstream processing:

Field Name	Description	Minimum Size	Maximum Size
ORGID	The originating trunk/extension.	1	7
TERID	The destination trunk/extension.	1	7
STARTIME	The time the call began.	4	6
DATE	The date of the call.	4	6
DURATION	The length of the call.	4	6
METER	Meter pulses (where applicable).	0	5
RING	Ring time (where applicable).	0	3
DIGITS	The actual digits dialed.	0	PBX Max.
ACCOUNT	An optional account code.	0	14
AUTHCODE	An optional authorization code.	0	10

The time fields are in a format that provides for hours, minutes and seconds. If seconds are not available then the accuracy of the reported data will be to the minute. The MDR-2000 defaults unavailable seconds fields to zero.

The date field requires month and day, or the Julian date which is the day of the year. The year field is not used.

In the digits field there is no absolute minimum. However, if digits dialed are not output then the CDR information is of limited value in downstream processing applications. The MDR-2000 can be programmed to accept as few digits as required.

Any records that do not match the format as described in the PBX specific ROM will be discarded. The MDR-2000 provides no error recovery for corrupt records from the PBX.

The output record from the MDR-2000 is in Expanded MDR Standard Format which is described in the following table:

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Field Name	Starting Position	Length (Bytes)	Type	Comments
Record Type		1	A	X or B
Record Number	2	3	9	Modulo 1000
Customer Number	5	2	9	Usually 00
ID Type	7	1	A	T, D, A or I
Originating ID	8	7	9	
ID Type	15	1	A	T, D or A
Terminating ID	16	7	9	
Date	23	4	D	mmdd
Time	27	4	9	hhmm
Duration	31	6	T	hhmmss
Flag Byte	37	1	9	(0 - 7)
Meter Pulse	38	5	9	
Digits	43		9	See Notes Below

ID Type: The ID type field indicates the type of originator or terminator of a call. 'T' for trunk, 'D' for extension, or 'A' for attendant. If the ID type for the Originating ID is an 'I' then this record is an image record and not a CDR record.

Flag: The Flag Byte is PBX specific and is designed to provide additional information about the call record. It is presented as a single digit from 0 - 7 which is interpreted as a bit pattern. Flag byte definitions are PBX specific, and as such may change depending on the PBX, the following bit definitions which have been assigned are; Bit 0 (Hex 1) indicates an expensive route was detected by the PBX, Bit 1 (Hex 2) indicates the call utilized the Answer Supervision capability, and Bit 2 (Hex 4) indicates that the call record was a transfer from an original call.

Meter Pulse: The Meter Pulse field will always be zero on systems which do not utilize the Meter Pulse feature.

Digits Field: The digits field has a variable length limited by the capacity of the PBX digits dialed field. This field also includes the ring time, account code, authorization code, and calling line identification fields. These fields are made part of the digits field because of their greatly varying attributes among different PBX's. On smaller systems none of them may be found. The following paragraphs describe each of the digits dialed subfields:

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Ring Time: The ring time, if present, will always be the first field in the digits dialed. It can be detected by the presence of a 'T' which is followed by the 3 digit ring time in seconds. If no 'T' is detected as the first character then there is no ring time field. Ring time is always reported if supported by the PBX.

Account Code: The account code is separated from the digits dialed by an '#'. The position of the account code may vary, and its presence is optional, therefore the downstream processing system must parse the digits field for the '#' and following digits.

Authorization Code: The authorization code is separated by a 'A'. The position of the authorization code may vary, and its presence is optional, therefore the downstream processing system must parse the digits field for the 'A' and following digits.

Calling Line Identification: The calling line identification is denoted by a 'D'. The position of the calling line identification may vary, and its presence is optional, therefore the downstream processing system must parse the digits field for the 'D' and following digits.

Fields are defined by their starting position in the record, the length in bytes and the type. Types are one of the following:

- | | |
|---|---|
| A | Alphabetic character (A through Z). |
| 9 | Numeric field (digits 0 through 9 and '.'). |
| T | Time field in the format 'hhmmss'. |
| D | Date field in the format 'ddmm'. |

Variable Fields: There is potential for other fields to be included in some models of the MDR-2000 and in data streams used as input to downstream processing. To facilitate these fields the 'I' designator in the Digits Dialed field has been employed.

If an 'I' is detected in the Digits Dialed field it will be followed by an indicator from '0' to '9'. The indicator specifies the type and length of the data to follow. Several indicators have been implemented as of this writing, as follows:

When 'I0' is detected in the Digits Dialed field the three digits following it are the **Hold Time** for the call. For example, if the string 'I0002' is found in the Digits Dialed field then this call has been on hold for 2 seconds.

When 'I1' is detected in the Digits Dialed field the three digits following it are the **Extended Duration Hours** digits for calls 100 hours and longer. These three digits concatenated with the

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two hour digits on the duration field can be used to construct a duration field in the format of '99999:99:99' for downstream processing.

'I9' is an optional field terminator. 'Ix' fields can be terminated based on several criteria. Firstly, the field may be of a fixed length, such as the 'I0' field. Secondly, the field may be at the end of the Digits Dialed field and therefore is terminated by the end of the record. Thirdly, the field may be variable length and have to be terminated by the presence of the 'I9' designator. In any event, any parsing routines should always detect 'I9' or the end of the record as the end of the current field.

Other Notes: If the record type is 'X' then this indicates a normal Expanded MDR Standard Format record. If the record type is 'B' then the MDR-2000 has detected an internal error on transmitting the record that has resulted in the record's contents being changed. The record can be discarded by the host system to avoid processing errors. In addition the MDR-2000 error indicator (LED CR4) is turned on. The presence of 'B' type records is symptomatic of a hardware malfunction in the MDR-2000.

If the record type is an 'N' then this indicates an older MDR Standard Format record which will be found in major release 1 and major release 2 version units. Please refer to the earlier MDR-2000 Reference Manual for details on this record format and the MDR-2000 capabilities.

3.1.2 Data Selection

As calls are received by the MDR-2000 they are scanned to ensure that they conform to the PBX specific format. If they do, then they are translated to Expanded MDR Standard Format, compressed and stored in the buffer storage.

Conformance includes two additional constraints. Firstly, the call duration must exceed the selected 'Minimum Call Duration', and secondly the number of digits dialed must exceed the 'Minimum Digits Dialed' value. These values are set using jumpers on the MDR-2000 or by commands to the Interactive Monitor which are described later in this manual.

An exception to the 'Minimum Digits Dialed' constraint are those calls with digits dialed whose beginning digits match the values set with the 'DIGITS TABLE' command in the Interactive Monitor. These sequences ignore the 'Minimum Digits Dialed' constraint.

If records do not conform they are discarded or may be stored in image format if image collection is enabled (see Interactive Monitor). Records that are discarded because they failed to meet the

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minimum constraints but are otherwise in the correct format are not collected by the image collection when discarded, only records that did not meet the PBX's CDR format are saved.

3.1.3 Data Translation

The actual process of translating PBX specific records into Expanded MDR Standard Format is relatively straight forward. Each field of an incoming record is analyzed as necessary to derive the information for the output record. The translation is dependent on the PBX being supported. Any fields which are not present, that can be defaulted, are set to specific values.

The customer number is defaulted to '00', the record number is assigned a sequential 3 digit number, and the auxiliary ID is defaulted to spaces. In addition, incomplete fields, such as a time field with no seconds, has the seconds field set to '00'.

Finally, the originating and terminating ID fields are right justified and zero filled if they are shorter than the maximum size. The digits dialed/account code field is terminated by a Carriage-Return/Linefeed pair.

3.2 Alarm Annunciation

When alarms are enabled the Alarm Table (see Interactive Monitor, Set Alarm, Set Primary Phone, Set Secondary Phone and Alarm Table commands for details) is scanned for each image record that is processed. When an entry in the table matches the starting characters of the image record then the repeat count for that entry is decremented. When the repeat count reaches zero it is reset and an alarm is raised. The MDR-2000 will then use the telephone number stored with the Set Primary Phone and Set Secondary Phone commands to dial a Hayes compatible modem and then dump an alarm message.

Note that these records are only retained in the MDR-2000's buffer if image collection is enabled (See Set Image command).

In order to successfully use this capability there must be a dedicated modem and computer at the receiving end to accept the alarm message. The MDR-2000 will output the formatted message when the modem at the receiving end answers the telephone.

The message is output with the standard MDR-2000 protocol layered around the alarm message as follows:

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Field #	Example	Description
1	X	Record type 'X' for expanded record.
2	01/19	Date of the alarm taken from the MDR-2000 (mm/dd).
3	12:42	Time of the alarm taken from the MDR-2000 (hh:mm).
4	012345	MDR-2000 serial number.
5	01	Site Number of the MDR-2000 (see Set Site command).
6	REMOTE1	Site Name of the MDR-2000 (see Set Name command). This field is 20 bytes in length, blank filled.
7	ERR009	Alarm code as generated by the PBX. The format is variable depending on the PBX. The MDR-2000 outputs codes in the form M2Kxxx: for internally detected alarm conditions.
8	Pwr. Failure	Alarm description in freeform as output by the PBX.

The Alarm Code and description fields will contain the exact string that caused the alarm. The Site Number field is used in cases where the receiving application may wish to poll the MDR-2000. This enables the application to determine the files in which to store the alarm data.

Note that this record format is compatible with MDR's Maintenance and Alarm Reporting System (MARS) which is the downstream processing module used with the MDR-2000 alarm features.

The MDR-2000 follows a specific algorithm in reporting its alarms and the host system (MARS) must accommodate this algorithm.

When an alarm occurs the MDR-2000 determines if an alarm is already being reported. If there is one in progress then the second alarm is not reported. The theory is that if one alarm is being reported for a PBX then successive messages within a short timeframe need not be annunciated. If their recording is important then image collection must be enabled.

If no alarm reporting is in progress then the MDR-2000 checks the Primary Phone Number field, and if valid begins the dialing process. When the line is busy or some other error is detected the MDR-2000 will retry autodialing up to the number of retries specified in the 'Set Retries' command (default 5). If the Primary Phone Number field is empty then it assumes a direct connection and simply sends the alarm record in the format previously listed with the appropriate protocol layer (see the Protocol section later in this document for details).

When the record has been sent as determined by the Primary Phone Number, it then directs its attention to the Secondary Phone Number. The MDR-2000 uses the Secondary Phone Number in

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exactly the same way as the Primary Phone Number except that if the entry is empty no action is taken. This is the means to suppress the reporting of an alarm to a secondary destination.

After the record is sent the MDR-2000 waits for an ACK character (06H) to be sent by the host. If no ACK is sent in approximately 2 seconds the record is retransmitted. Any character other than the ACK also causes the record to be retransmitted. The retransmission will occur up to 10 times after which the MDR-2000 will simply disconnect.

3.3 External Alarm Generation

On certain models of the MDR-2000, those with 24 external jumpers labeled 'A' through 'X', detection of external events is possible. When power is first applied to the MDR-2000 it retrieves and stores the status of the 24 jumpers for reference. When the condition of one of the jumpers changes this generates an alarm.

The alarm is reported with a condition code of 'M2KEXT:' followed by the letter corresponding to the jumper. If multiple jumpers change simultaneously then they will all be reported on the same alarm message.

These jumpers report a change in the condition of the jumpers, and give no indication of the open or closed status of the jumper. Therefore it is incumbent on the implementers of the system to ensure that the initial condition of the jumpers is what is expected as normal. The change in jumper condition must be held for a least 1/2 second, a feature incorporated to help reduce nuisance alarms and also to help with the circuit debouncing logic.

In designing circuitry to open or close the jumpers the implementers must be careful not to apply any voltage or current to the jumpers that may damage the MDR-2000. As a guideline, the circuit must be equivalent to a dry reed relay contact closure.

3.4 Internal Alarm Generation

The MDR-2000 has the capability of reporting internally generated alarms which result when certain conditions internal to the unit occur. These messages are reported in the same format as the external and PBX generated messages described in the previous sections. The following is a description of the internally generated alarms:

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Code	Message	Description
M2KTHR	Storage Threshold Exceeded	The threshold set with the Set Threshold command has been exceeded
M2KIDL	PBX Idle Time Threshold Exceeded	This alarm indicates that the PBX has not output any information to the MDR-2000 in the interval specified with the Set PBX Idle command.
M2KPBD	M2K Possible Battery Depletion	Indicates that a possible depletion of the internal backup batteries has been detected (specially equipped units only).
M2KCCD	Contact Closure Detected	Indicates that an internal contact closure has been detected (specially equipped units only).

3.5 Modem Setup

The MDR-2000 is usually not aware of the type of modem that is connected or if in fact it is connected to a modem or directly to the host computer. When a modem is used it must meet certain criteria in order for successful operation with the MDR-2000.

The modem must be asynchronous and support the standard 'AT' modem command set, which is also known more commonly as the Hayes command set. The modem must be configured for 'Full Word' or 'Verbal' responses. These are sometimes referred to as results codes. This is the default setting for most modems, but can be set by entering the commands 'ATQ' or 'ATQ0' to enable results codes, and 'ATV1' to setup the modem for 'Full Word' responses.

Character echo to the 'AT' commands must be suppressed. This is done by entering the command 'ATE' or 'ATE0'. The default is 'ATE1' which causes the modem to echo characters. As well the modem must be set to auto-answer mode. This permits the modem to answer the telephone line when the host computer's modem is dialing to collect data. The command to enable auto-answer mode is 'ATS0=1'. This sets the modem to answer the telephone after 1 ring. The default is to disable auto-answer mode so this command is essential.

These options must be setup *before* the modem is placed in the field. They are saved by entering the command 'AT&W'. Whenever the modem is reset by an 'ATZ' command or powered up the settings stored by the 'AT&W' are used.

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If your modem has jumper settings make sure that the modem is not set for 'dumb' mode operation. If it is none of these commands will work. If you are unsure of the status of the settings you can restore the original factory defaults by entering the command 'AT&F'.

Chapter 4

COMMUNICATIONS

The purpose of this section is to describe the commands and protocols used to control and communicate with the MDR-2000. Commands are necessary to operate the MDR-2000, while the protocols are used to ensure data integrity over transmission lines.

The MDR-2000 supports a two level command structure. The first level, described here, is used primarily for computer-to-computer communications. The commands are structured to enable the MDR-2000 to transfer large volumes of call data to a host computer for downstream processing.

The second level of commands is implemented in the Interactive Monitor and these commands are designed for human interaction. The commands are structured to provide remote operation and diagnosis of the MDR-2000. The Interactive Monitor is described in Section 5.

4.1 Computer-To-Computer Commands

The MDR-2000 operates over full duplex lines at speeds up to 19200 Baud. This full duplex capability is essential for remote control of the MDR-2000. Commands to the MDR-2000 are used to specify a single operation to be performed by the unit.

Commands utilize a very simple protocol when being transmitted to the MDR-2000. Each command is preceded by a SYN (ASCII 16H, or Control-V) character and terminated by a carriage-return (ASCII 0DH). The commands themselves are all two characters long.

Commands partially entered in error can be eliminated by simply typing the SYN character followed by the correct command. The normal keyboard editing characters such as Delete or Backspace have no meaning. The command does not echo on the user's terminal. This is consistent with the operation under program control, which is the normal case.

The computer-to-computer commands are as follows:

BE - The 'BEgin' command moves the buffer pointers to the beginning of the current data storage buffer. This command must be used with caution since it may result in duplicate data in the downstream processing facility. There is no reply from the MDR-2000 to this command.

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CA - The 'Collect All' command indicates that both CDR and Image data are to be transmitted sequentially, as they occur in the buffer, to the data collection software. This is the default mode of operation. An 'OK' message is returned when the command is received and executed properly, and an 'ERR' message if SET DESCRETE COLLECTION FUNCTIONS is not enabled. The 'OK' and 'ERR' messages are encapsulated in the same protocol used for data transmission.

CC - The 'Collect CDR' command indicates that only CDR data will be transmitted to the host. Image data records will be skipped. An 'OK' message is returned when the command is received and executed properly, and an 'ERR' message if SET DESCRETE COLLECTION FUNCTIONS is not enabled. The 'OK' and 'ERR' messages are encapsulated in the same protocol used for data transmission.

CI - The 'Collect Image' command indicates that only Image data will be transmitted to the host. CDR data records will be skipped. An 'OK' message is returned when the command is received and executed properly, and an 'ERR' message if SET DESCRETE COLLECTION FUNCTIONS is not enabled. The 'OK' and 'ERR' messages are encapsulated in the same protocol used for data transmission.

CL - The 'CLear' command causes the erasure of data from the beginning, up to but not including the current buffer pointer location, in the currently selected data storage buffer. A 'CLR' message is returned when the clear action is complete. The 'CLR' message is encapsulated in the same protocol used for data transmission. This command also causes the 'ERR' LED to be reset.

If the SET DESCRETE COLLECTION FUNCTIONS option is selected and 'CC' or 'CI' is in effect then this command has additional functions. Under these circumstances it will force a 'BE' command followed by a 'CA' command. The result is to move the data collection pointers to the beginning of the buffer and then advance to the first non-deleted record, either CDR or image type. If there are none then it simply moves to the end of the buffer which is exactly the same function that it has when SET DESCRETE COLLECTION FUNCTIONS is disabled.

For example, to collect CDR data followed by image data the host data collection software can send a 'CC' command and then collect all of the CDR data. When the 'CL' command is issued followed by a 'CI' command the MDR-2000 will be positioned so that the host data collection software can now collect the image data.

CT - This command causes a short diagnostic message to be displayed indicating the hardware platform for which the microcode resident in the EPROM has been generated. This command is useful in the manufacturing process to ensure that the correct EPROM has been installed on a particular platform.

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DB - The 'Door Bell' command causes an immediate 'HE' response, followed by a Carriage Return/Linefeed pair, from the MDR-2000. It is used to ensure that the MDR-2000 is active and waiting for commands. This command also cancels an active 'DU' command and issues a 'CA' command to cause collection of both CDR and Image data.

DU - The 'DUmp' command causes all data received on the PBX port to be immediately output over the modem port. Data continues to be collected normally. The data dumped over the modem port is unedited. When the Interactive Monitor is activated this command is canceled. There is no reply from the MDR-2000 to this command. Note that execution of the 'IM', 'SD', 'FD' or 'DB' commands causes cancellation of the dump.

FD - The 'Formatted Dump' command causes the MDR-2000 to output formatted CDR records automatically over the modem port as they are processed. These records are in exactly the same format as those output by the 'XT' command including the protocol information. This command is useful for 'trickle transmit' applications where the MDR-2000 will be on-line at all times. Note that execution of the 'IM', 'SD', 'DU' or 'DB' commands causes cancellation of the formatted dump.

ID - The 'IDentification' command outputs several lines of text containing information about the MDR-2000 including the PBX generic supported, software revision, serial number, and copyright notice. No protocol is used with this output.

IM - The 'Interactive Monitor' command invokes the Interactive Monitor, if present. When invoked, an active 'DU' command is canceled. Data collection proceeds as usual. Any other computer-to-computer command, preceded by the requisite SYN character, will cause the Interactive Monitor to exit.

MR - The 'Master Reset' command is used to reset the entire MDR-2000 system. This command causes an immediate hardware reset with the loss of all data. There is no reply from the MDR-2000 to this command.

OK - The 'OK' command is used to advance the buffer pointer to the next logical record in the currently selected data storage buffer. There is no reply from the MDR-2000 to this command. Its successful reception by the MDR-2000 can be tested by transmitting a data record and comparing it to the previously transmitted record. If they are the same the 'OK' command was not received by the MDR-2000 correctly.

Note: If the SET DESCREE COLLECTION FUNCTIONS option is selected and the 'CI' or 'CC' commands are in effect then **the 'OK' command is destructive**. Any records which are passed over by the 'OK' command are marked as deleted and cannot be recovered by using a 'BE'

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command and recollecting. In practice the 'BE' command is seldom used for this purpose so that this characteristic of the 'OK' command is of little practical value.

RB - The 'Repeat Block' command is used in conjunction with the 'XB' command to retransmit a block of records. Only a single 'RB' can be used and it can only be used after an 'XB' command. It is only required if the downstream data collection facility detected an error in a block of records sent using the 'XB' command.

RN - The 'Reset NVR' command will force initialization of the non-volatile RAM (NVR) to the factory settings. There is no reply from the MDR-2000 to this command.

RP - The 'Reset Port' command initializes the PBX port, clearing any errors that may have caused the port to cease operation. There is no reply from the MDR-2000 to this command.

SD - The 'Stop Dump' command cancels the DU command. This command is automatically invoked when the Interactive Monitor is activated. There is no reply from the MDR-2000 to this command.

SM - The 'Send Maintenance' command is used to transmit an MDR-2000 maintenance record to the host system. This record is not the same as a PBX maintenance record; it pertains to the MDR-2000 itself and not the PBX. The record is encapsulated in the same protocol used for data transmission.

TE - The 'TEst' command causes a single line of test characters to be dumped over the modem port. No protocol is used with this output.

VW - The 'VieW' command displays the last invalid record received on CDR configurations. If no invalid records have been received, the word 'Empty' will be issued. No protocol is used with this output.

XB - The 'Transfer Block' command send a block of records at the current buffer pointer location in the currently selected data storage buffer. Each record is individually encapsulated in the protocol described in the next section. An 'END' message is returned when the buffer is empty or the pointers have been advanced past the last block of records in the buffer. Advancement of the pointers to the next block of records is automatic. Therefore successive 'XB' commands return successive blocks of records. Use the 'RB' command to repeat a block if an error is detected in the transmission of any record in the block. If insufficient records are stored for a complete block then a partial block will be sent.

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XT - The 'Transmit' command sends the record at the current buffer pointer location in the currently selected data storage buffer. This record is encapsulated in the protocol described in the next section. An 'END' message is returned when the buffer is empty or the pointers have been advanced past the last record in the buffer by the 'OK' command.

19 - Sets the modem and PBX port baud rates to 19200 temporarily. This command is used for automated testing of the MDR-2000. The MR command causes them to reset to their previous values.

4.2 Protocol

The MDR-2000 utilizes protocols to ensure the integrity of the data transmitted to the host system. There is no protocol used between the MDR-2000 and the various PBXs. The following paragraphs describe how the collection process should be handled by any third-party utility that is designed to download data from the MDR-2000. The process described is for transferring data a single record at a time. Refer to the section on 'Large Blocksize Polling' for details on downloading multiple records per transfer request.

The first level of protocol applies to the coordination of communications between the MDR-2000 and the host system. This protocol is basically summarized by the fact that the MDR-2000 transmits data only when requested by the host. The MDR-2000 never initiates data transmission. Even when it dials the host system for alarm conditions the host must initiate the transmission of data.

In some cases proper reception of commands from the host to the MDR-2000 must be inferred. For example, if the 'ID' message is returned, then one can safely infer that the 'ID' command was properly received by the MDR-2000.

A more difficult situation is the 'OK' command. To ensure its correct reception the previous record transmitted as the result of an 'XT' command must be compared to the current record transmitted. If they are different then it is a proper assumption that the 'OK' command was properly received and processed by the MDR-2000.

There are some commands for which proper reception cannot be inferred. These are the 'XT' and the 'CL' commands. To ensure accurate communications with the MDR-2000 these commands return values, encapsulated in a data packet.

This second level of protocol, which uses the data packet, applies to the transmission of call records from the MDR-2000 to the host system only. In addition, the 'CL' command responds with a 'CLR' message which is also sent as a data packet.

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The packet consists of the data message encapsulated in the protocol. The data is preceded by two SYN (ASCII 16H) characters, an 8-bit byte count, a 3 byte modulo 1000 sequence number, and the Customer Number which is usually '00'. The data follows the byte count and it is followed by 2 8-bit characters containing a 16-bit checksum of the data.

The first byte in the checksum is the low order digit and the second byte the high order digit. The highorder bit (bit 7) of both checksum bytes is always '0'. The checksum is an arithmetic sum of the data portion of the packet. If either byte calculates to a '0DH' then that byte is incremented by '1'.

The last byte in the message is always a Carriage-Return which is used as a record terminator in packet-switched networks.

In the case of blocks of records transmitted by the 'XB' command, each record retains the same format described above. This includes the two SYN characters and the terminating Carriage-Return on *each record* in the block. It is the responsibility of the downstream processing facility to process each record in the block.

All retransmission is handled by the host system, as it is responsible for testing the checksum and, because the MDR-2000 never initiates communication, it is the host system's responsibility to handle error conditions by requesting retransmission.

In the case of CDR data the data collection routine should check the first character for a 'X' (Normal expanded record) or 'B' (Bad record) and take appropriate action. When the record is stored, a record terminator (Carriage-Return/Linefeed) may have to be appended depending on the recording device and method.

A collection routine can determine if the information from the MDR-2000 is CDR or image data by examining the ID Type following the Customer Number. If this is an 'I' then the remainder of the record constitutes the image data received from the PBX (or other device).

4.3 Discrete Polling

Under normal circumstances the MDR-2000 collects call detail (CDR) data which is preprocessed and optionally any non-CDR data which it stores in an unprocessed image format. When polled by a host system the CDR and image data records are transmitted in the order they arrived from the PBX. The host system can separate the two formats of data by testing the record type affixed by the MDR-2000 when it processes the data records. This is done automatically by the downstream data collection modules found in MDR products.

Certain users may find it necessary to collect CDR data at one site, or on one downstream machine, and image data on another. For these applications discrete polling of CDR or image data has been implemented in the MDR-2000. With the discrete polling commands it is possible for polling modules on host computer systems to collect either CDR or image data and have other processes on another host computer collect the remaining type of data.

The discrete polling commands are all covered under sections of this manual dealing with the commands and details on them can be found there. The commands used in discrete polling are SET DESCREE COLLECTION FUNCTIONS found in the Interactive Monitor, and the computer-to-computer commands; CL, CA, CI, CC, OK, DB and BE.

The process of discrete polling is implemented by the cooperative effects of the MDR-2000 and the downstream polling module. Firstly, the MDR-2000 must have the discrete polling capability enabled by using the SET DESCREE COLLECTION FUNCTIONS command in the Interactive Monitor. Then when polling is initiated the host collecting CDR data must issue the 'CC' command before it begins collecting. This command indicates that the downstream facility only wishes to receive the CDR data.

When the end of the data is reached the downstream facility must issue a 'CL' command to clear the buffer. This has the effect of moving the MDR-2000's pointers back to their values before data collection began and then advanced to the first image record. When the second downstream process begins collecting it must issue a 'CI' command to indicate that it only requires the image data.

It is noteworthy that the 'DB' command used to determine if an MDR-2000 is active always issues an automatic 'CA' command to effectively disable discrete collection. As well the 'OK' command that is used to advance the MDR-2000's pointers to the next record for collection now skips over any record of the wrong type, and flags the last transmitted record as deleted. This operation is largely invisible to the user or programmer interfacing with the MDR-2000. Finally, it should be noted that if discrete collection is in progress and only one type of record is being collected (say

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CDR for example) then the MDR-2000 may become full with image records and deleted CDR records even though the data collection process reveals that the buffer is empty of records.

Also in this case the residual deleted CDR records will still be reflected in the 'Number of Records Stored' and 'Records to be Collected' fields of the SHOW STATUS command in the Interactive Monitor. Therefore these fields remain accurate indicators of the storage utilized in the MDR-2000 but not necessarily true indicators of how many valid records remain.

4.4 Large Blocksize Polling

Polling records in blocksize greater than one can significantly improve data transmission rates at higher baud rates, but is more prone to errors since the blocks of data are larger. The larger blocks means that if an error occurs the entire block must be retransmitted. Using this feature is usually not necessary but has been included with the MDR-2000 for large installations, such as service bureau operations, where the elapsed time for overnight data collection is sometimes a constraint.

The MDR-2000 must be configured to transmit data in blocksize greater than 1 record per block. This is done by using the SET XFER BLOCK command in the Interactive Monitor. Blocksize from 1 through 255 may be specified.

Two dedicated computer-to-computer commands are used to transmit large blocks of records. These are the 'XB' and 'RB' commands which are both described in the section on 'Computer-to-Computer Commands'. Using the Transfer Blocksize does not affect the use of the regular computer-to-computer commands, 'XT' and 'OK', used in downloading single record blocks.

The 'XB' command is used as a replacement for the 'XT' command to transmit a block of records. Each record in the block has a complete protocol as described in the section 'Polling' in this manual. Successive 'XB' command download successive blocks of records, the 'OK' command is not used and there is no replacement for it when working with large blocks.

If an error is detected in any of the records in a block then the entire block must be retransmitted. Since the MDR-2000 has already indexed to the next block after the completion of the previous 'XB' command it is necessary to issue an 'RB' to reset the pointers to the previous block. Only one 'RB' command can be used, they cannot be stacked to move backwards multiple blocks.

When the end of the recorded data has been reached a partial block may be transmitted. This will be followed by one more block which contains the 'END' record. The 'CL' command should then be used to erase the downloaded data from the MDR-2000 thereby freeing up the storage for new data from the PBX.

4.5 Data Transmission

The MDR-2000 utilizes asynchronous data transmission techniques. It is programmed for 8 data bits, no parity, and 1 stop bit. Except for the specific cases described below, only 7 of the 8 data bits are actually used, the high order bit being removed under software control. Note however that the MDR-2000 is programmed to receive 8 data bits and therefore any communications equipment interfacing with the MDR-2000 must be programmed accordingly.

In the situation where parity is forced on the data, and therefore only 7 data bits are possible (as in some public packet switching services), communications with the MDR-2000 is still possible. This is accomplished by noting that the MDR-2000 never sends a packet larger than 127 data bytes in any of its current configurations. This means that the byte count never occupies more than 7 bits. In addition the two 8-bit checksum bytes (16-bit checksum) can be treated as two 7-bit checksum bytes.

4.6 LED Indicators

To provide immediate diagnostic and operational feedback a series of 8 LED indicators are used by the MDR-2000. These indicators are designated CR2 through CR9 on the circuit boards. Their meanings are listed on the table below. On units where they are externally visible the external labels are denoted in the table.

When all of the LEDs are on simultaneously the MDR-2000 is in the initialization sequence. The troubleshooting section of this manual contains more information on the interpretation of these LED's.

When CR7 is flashing, but not constantly on, the MDR-2000 has reached its call threshold setting (see SET THRESHOLD command in Chapter 5). When CR7 is constantly on then the buffer is full and calls are being discarded.

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Mnemonic	LED	Value	Description
MSD	CR2	ON	Modem port transmitting to host
MRD	CR3	ON	Host system transmitting to modem port.
ERR	CR4	ON	MDR-2000 hardware error has occurred.
PBX	CR5	ON	PBX transmitting to PBX port.
BMT	CR6	ON	MDR-2000 buffer empty.
		OFF	MDR-2000 buffer not empty, call records are being stored.
BFL	CR7	ON	MDR-2000 buffer full, additional call records are being discarded.
		Flashing OFF	Preset threshold reached, buffer not full. MDR-2000 buffer not full.
INT	CR8	ON	MDR-2000 processing a hardware interrupt.
RUN	CR9	ON	MDR-2000 running in non-interrupt mode.
		OFF	MDR-2000 not operational.

Chapter 5

INTERACTIVE MONITOR

The purpose of this section is to describe the operation of the Interactive Monitor. The Interactive Monitor provides interactive access to the MDR-2000 hardware for maintenance, diagnostic and inquiry purposes.

The Interactive Monitor may be viewed conceptually as a distinct software component that probes the various data areas of the MDR-2000 and provides results or modifies data. It does not affect the data collection, except that it can modify the operating parameters.

Some of the commands provided by the Interactive Monitor are identical to those provided by the computer-to-computer commands of the MDR-2000. They are provided again in the Interactive Monitor for convenience.

To invoke the Interactive Monitor the 'IM' command must be issued and the option must be installed on the MDR-2000. If the option is not installed then the command is ignored. When the Interactive Monitor is in operation the commands of the standard command processor are not active. If dump mode ('DU' command) is in effect it is canceled.

Data collection is performed while the Interactive Monitor is active except during certain test functions. When the data collection is disabled the Interactive Monitor will indicate this with a message.

5.1 Command Processor

The Interactive Monitor's command processor is engineered for human operation as opposed to the standard MDR-2000 command processor which is engineered for computer-to-computer communications.

When the Interactive Monitor is invoked, a short signon banner is printed on the terminal. This is followed by the command processor's prompt 'M2K>' indicating it is ready to accept commands. The display appears as follows:

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Interactive Monitor

MDR-2000e Interactive Monitor
Copyright (c) 1986-2000 MDR Technologies Inc.

M2K>

As commands are typed to the Interactive Monitor they are echoed on the user's terminal. When a command, or field, is recognized as unique by the command processor it is automatically carried out on the user's terminal. Arguments or options can then be selected. Arguments are terminated by pressing the <Enter> key. Some command strings must be terminated by pressing the <Enter> key to execute the command, others execute immediately when recognized.

When a mistake has been made, pressing <Control-C> (Press the <CTRL> key while simultaneously pressing the character 'C') will result in the command line being discarded. The command processor will print the message 'Canceled' on the user's terminal as an indicator that the command has been discarded.

Whenever a character is typed that is illegal in the current context, then the character is ignored and the <Bell> is echoed. The <Bell> is a signal to the user that an invalid character has been entered.

The execution of any command can be interrupted by typing <Control-C> at any time.

5.2 Command Descriptions

The following paragraphs describe the individual commands and their associated options. Generally each command can have 0, 1 or 2 options. These options may be keywords or arguments.

Keywords are entered and recognized by the command processor as commands. That is, when the system recognizes what keyword is being entered, the option is completed automatically by the command processor.

Arguments are one of three types: numeric, ASCII, or MDR BCD.

Numeric arguments fall into 3 classes: addresses, values, or repeat counts. Addresses range from 0 to FFFFFFFF hexadecimal, values range from 0 to FF hexadecimal, and repeat counts range from 0 to 65,535 decimal. Unless otherwise noted, omitted numeric arguments default to 0.

ASCII arguments can be any character that the keyboard can generate. Characters that are not printable are echoed as '.', the period. When an ASCII argument is omitted the default is NULL.

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MDR BCD is a special subset of characters used for internal storage of CDR data. MDR BCD arguments consist of the digits plus the characters 'D', 'A', 'T', '#', and the space.

ADVANCE - This command advances the current record pointer forward one record. If the pointer is at the end of the buffer, no action is taken.

ALARM TABLE - This command is used to enter and modify the alarm condition table for alarm and maintenance applications.

BEGIN - This command moves the record pointer to the first logical record. Since the pointer is moved to the beginning of the buffer the effect is to permit those records to be collected again. Duplicate records may occur in the downstream processing if this command is used without regard for data already collected. The ADVANCE command can be used to reduce the data duplication possibilities.

CLEAR - This command causes the Logical Error Count and the I/O Interrupt Status to be set to zero. In addition the ERR LED is cleared. This command is not the same as the 'CL' command described in the computer-to-computer communications section.

CUSTOMIZE - This command is used to enter the field settings and PBX customization options when minor adjustments are required to translate PBX data into Expanded MDR Standard Format.

DIGITS TABLE - This command is used to enter and modify the call exception table for CDR applications.

DUMP <Addr> <Repeat> - This command prints the contents of memory locations beginning at the address specified and repeating as indicated. The RAM command is used to select which memory is accessed, either processor or buffer memory. The MODE command determines the format of the data. The address is printed in the leftmost column followed by 16 bytes of data.

HELP - This command provides a display of the commands available through the Interactive Monitor.

IDENT - This command prints the MDR-2000 identification message which contains the PBX generic, revision numbers and copyright notice. This information is extremely useful in isolating data collection problems. The following is an example of the output:

MDR-2000 Plus
Meridian 1 Generic

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Rev. 3.S34.G41

Ser. 003423

Copyright (c) 1999 MDR Technologies Inc.

MODE - This command sets the mode for DUMP and PUT command value arguments. It executes automatically when recognized by the monitor and toggles the mode between hexadecimal, ASCII and MDR BCD input and output. The default is hexadecimal.

OPEN LINK - This command causes the MDR-2000 to permit two way communications from the modem port to the PBX port which in effect makes the MDR-2000 act as a direct cable. This allows the user to interactively communicate with their PBX for maintenance related tasks. The command is terminated by pressing either <Control-C> or <Control-V>. Data collection and alarm annunciation are disabled during an Open Link session.

PUT <Addr> <Value> <Value> ... <Value> - This command puts the contents of the string beginning at the address specified. Up to 16 values may be entered on the command line. Each value must be separated by a space or comma. The RAM command is used to select which memory is accessed, either processor or buffer memory. The data format is determined by the MODE command.

QUIT - This command causes an exit from the Interactive Monitor and returns control to the MDR-2000's standard command processor. Pressing <Control-V> at any time has the same effect as entering the QUIT command.

RAM - This command sets the physical RAM that is used for memory addresses. It executes automatically when recognized by the monitor and toggles the memory selection between the large buffer memory used to data records, and the smaller processor memory used for program execution. The default is processor RAM.

READ - This command outputs the current record. It is similar in operation to the 'XT' command in the MDR-2000 command processor except that no protocol is used, and it is terminated by a carriage-return/linefeed.

SET <Keyword> - This command sets various parameters in the MDR-2000. If the MDR-2000 is Rev. 03 or earlier then the hardware does not support non-volatile RAM (NVR) and therefore these values will be reset after a hardware reset. On later models the values will be automatically restored after a hardware reset. The keywords and their meanings are listed in the paragraphs below:

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SET ALARM <Keyword> - If 'Yes' then critical alarms cause the MDR-2000 to dial the host system.

SET BAUD <xxxxx> <yyyy> - Sets the baud rates where xxxxx is the PBX port rate and yyyy is the modem port baud rate.

SET BEEP <Keyword> - If 'Yes' then the <Bell> character is signaled when an invalid character is entered in response to an Interactive Monitor prompt.

SET BYTE SIZE <x> <y> - Set the port byte sizes where x is the PBX port byte size and y is the modem port byte size.

SET CDR - <Keyword> - If 'Yes' then CDR data is collected, if 'No' then CDR data is discarded.

SET DATE <dd> <mm> - Set the default date.

SET DESCRETE COLLECTION FUNCTIONS - Enables and disables the data collection commands ('CA', 'CI' and 'CC') which provide for collection by the host of either CDR data or Image data only. Note that the word 'DESCRETE' is the required spelling.

SET DIGITS <Value> - Sets the minimum digits dialed.

SET DURATION <Value> - Sets the minimum call duration.

SET EXT->EXT <Keyword> - If 'Yes' then internal calls are collected, if 'No' then they are discarded.

SET HELP - Provides a list of the SET command parameters.

SET IDLE PBX <Value> - Sets an alarm interval which monitors PBX activity.

SET IMAGE <Keyword> - If 'Yes' then non-CDR data is collected, if 'No' then it is discarded.

SET INCOMING <Keyword> - If 'Yes' then incoming calls are retained, if 'No' then they are discarded.

SET METER <Keyword> - If 'Yes' then the meter pulse field (if it is implemented) of the PBX will be scanned for valid data, if 'No' it will be ignored and the output will always be '0'.

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SET MULTI TENANT <Keyword> - If 'Yes' then for generics which support multi-tenant operation then on output the customer number field will contain a number corresponding to the tenant.

SET NAME <Value> - Assigns a name to the MDR-2000.

SET OPTIONS <Value> - Accepts a string of characters used to specify certain MDR-2000 feature settings.

SET PARITY <x> <y> - Set the ports' parity where x is the PBX port parity and y is the modem port parity.

SET PORT RESET <Value> - Sets a timeout interval for the RS-232 ports. If this time elapses with no activity then the ports are reset.

SET PRIMARY PHONE <Value> - Sets the first phone number dialed when an alarm occurs.

SET RETRIES <Value> - Set the number of autodialer retries when attempting to annunciate an alarm condition.

SET SECONDARY PHONE <Value> - Set the second phone number dialed when an alarm occurs.

SET TANDEM <Keyword> - This option is used in situations where the originating ID and terminating ID are both trunks but for data reporting purposes the originating ID is to be designated as an extension. When selected the originating ID in trunk-to-trunk calls is converted from a 'T' designator to a 'D' designator.

SET THRESHOLD <Value> - Sets the storage limit when an alarm is raised.

SET TIME <hh> <mm> - Set the default time.

SET SITE <Value> - Assigns a site number to the MDR-2000.

SET XFER BLOCK <Value> - Sets the number of records to be transmitted in a block in response to the 'XB' command.

SHOW <Keyword> - The purpose of the SHOW command is to provide a general mechanism to output information based on a specific keyword which allows for expanded data output as the MDR-2000 evolves. This command is only available on MDR-2000 units with software revision 3.S01.G08 or later. The keywords and their meanings are listed in the paragraphs below:

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SHOW ALARM - Displays the contents of the Alarm Table.

SHOW AUTODIAL - Lists information used by the autodialer including retry thresholds and the user programmable telephone numbers.

SHOW DIGITS - Displays the contents of the Digits Table.

SHOW HELP - Provides a list of the SHOW command parameters.

SHOW IDENT - Displays data identifying the MDR-2000 software including PBX generic supported, software revision, serial number, copyright notice, site number and site name. This command is an expanded version of the ^VID command.

SHOW MAINT - Displays maintenance data for diagnostic purposes. It is identical to the ^VSM command except that no transmission protocol is used.

SHOW PORT - Displays the settings for the RS-232 ports and other miscellaneous data collection settings on the MDR-2000.

SHOW STATUS - This command is identical to the STATUS command described earlier.

STATUS - This command outputs a comprehensive display indicating the values of the various parameters within the MDR-2000. The values output are as follows:

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Date/Time (mmdd hh:mm)	Option Settings
Number of Records Stored	Records to be Collected
Port Config (PBX/Modem)	Minimum Duration
Incoming Calls	Minimum Digits
CDR Collection	Image Collection
Meter Pulse Detection	Multi Tenant Detection
Tandem Conversion Option	Internal Calls (Ext->Ext)
Last Scan Error Position	Alarm Threshold
Logical Error Count	Alarm Enabled
Buffer Memory Size	I/O Interrupt Status
Site Name	Site Number
Primary Telephone Number	
Secondary Telephone Number	

When using Discrete Collection Functions, 'CI' and 'CC' the record counts will always reflect the total number of call records. This is because records are not physically deleted until both Image and CDR records have been collected.

For example, in the case where 'CI' mode is set and the image records collected, the final 'CL' command used to clear the processed records will position the MDR-2000's internal registers to the first CDR record to be collected. The record counts will now include all of the records from the first CDR record to be collected to the last CDR record, including any already collected image records which may be interspersed.

This is valid since they still occupy space and do affect the remaining storage capacity of the unit. These values are cosmetic only and do not affect the operation of the MDR-2000.

TEST <Keyword> - This command is used to run a series of nondestructive tests on the MDR-2000 hardware to check for malfunction. These tests each disable data collection. The keywords and their meanings are listed in the table below:

TEST HELP - Provides a list of the TEST command parameters.

TEST LOGICAL - Checks the integrity of stored data and reports any errors.

TEST NVR - Checks the integrity of the NVR against those values stored in RAM.

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TEST PORT - Sends a test pattern over the modem port.

TEST RAM - Test the processor ram for errors.

Tests can be aborted by entering <Control-C> at any time.

VIEW - This command causes the last record rejected by the MDR-2000 in CDR configurations to be output.

5.2.1 Set Command Details

The SET command provides for a number of options each affecting the way data is collected. This section deals with each of these options and the way they are implemented by the Interactive Monitor.

When setting a value using this command, the value is only changed when the command is entered successfully. This means that when an error is detected in an argument, or <Control-C> is typed prior to pressing the final <Enter> key, the value in question is not changed.

In cases where two arguments are to be set, such as the SET BAUD command, changing one argument does not affect the other. If however, one of the arguments is invalid then neither argument is changed.

The following paragraphs deal with each of the SET command options.

SET ALARM - This option accepts either 'Yes' or 'No' as an argument. If 'Yes' is selected then the MDR-2000 will dial the host system, using the telephone numbers specified with the SET PRIMARY PHONE and SET SECONDARY PHONE commands. The alarm is raised when the number of calls specified by the SET THRESHOLD command is reached. The default setting is 'No'.

SET BAUD - This option accepts two values which specify the baud rate to be used on the PBX port and the modem port respectively. The baud rates that may be selected are 300, 600, 1200, 2400, 4800, 9600 and 19200. The default setting is '1200' baud for the PBX port and '9600' baud for the Modem port.

After entering the PBX baud rate the <Enter> key must be pressed for the modem baud rate prompt.

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Care must be taken when changing the modem baud rate since the host terminal must also have its baud rate changed before communications can continue. The change in baud rates takes effect only after exiting the Interactive Monitor.

Also note that if the change is made over a modem that the modem's speed must be altered. Many modems will allow 300, 1200 and 2400 baud communications but a new call will have to be established before the changed baud rate will take effect. If a baud rate that is not supported by the modem is selected the MDR-2000 will NOT be able to communicate.

It is not essential that both baud rates be at the same setting, however it is preferred. In any case, the PBX baud rate should never be greater than the modem baud rate.

SET BEEP - SET BEEP <Keyword> - If 'Yes' then the <Bell> character is signaled when an invalid character is entered in response to an Interactive Monitor prompt. If 'No' then invalid characters are simply ignored. In situations where the Interactive Monitor is used extensively, such as with the 'Open Link' command to PBX maintenance, the preferred setting is 'No'. This will help inhibit modem locking problems that can occur when the modem and the Interactive Monitor echo the <Bell> in response to line noise. The default is 'Yes'.

SET BYTE SIZE - This option accepts two values which specify the byte size to be used on the PBX port and the modem port respectively. The byte sizes that may be selected are 5 through 9. The default setting is '8'.

After entering the PBX byte size the <Enter> key must be pressed for the modem byte size prompt.

Care must be taken when changing the modem byte size since the host terminal must also have its byte size changed before communications can continue. Note that changing the byte size can be limit the ability of many communications programs to handle different parity settings. For example, with a byte size of 8 many programs (i.e. EasyCom) will not allow the parity to be set to anything except 'N' for no parity.

SET CDR - This option accepts either a 'Yes' or 'No' argument. If 'Yes' then the selective CDR processing routines to analyze and pack calls are used, otherwise they are not used and all data is treated as image data. The default setting is 'Yes'.

SET DATE - This option accepts the date in the form 'mmdd'. The date is only used for those PBX generics that do not provide a date field in the CDR record format. In addition, for those PBXs which output only a daily date the SET DATE command provides an interim date until a date record is encountered. The date output by a PBX will always supersede this date.

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If a valid date cannot be determined then all calls are discarded. This feature is valid in CDR configurations only.

SET DESCRETE COLLECTION FUNCTIONS - This command enables and disables the ability of the MDR-2000 to selectively transmit CDR data and/or image data. If this command is set to 'No', which is the default setting, then when being polled the MDR-2000 will transmit both CDR and image data intermixed. The MDR data collection programs will separate the data for the user when it is received at the host computer.

If set to 'Yes' then the polling software can selectively determine that it wants only the CDR or image data. This feature allows the CDR data to be polled by one host computer and the image data to be polled by another host computer. The data collection commands used in this process are 'CA', 'CI' and 'CC'.

SET DIGITS - This option sets the minimum number of digits that be dialed before the call is stored. Calls with this number or fewer digits are discarded unless they begin with a sequence of digits contained in the retention table. The default value of '0' accepts all calls. This feature is valid in CDR configurations only.

SET DURATION - This option set the minimum call duration in seconds. If a call is placed which has a duration equal to or less than the number of seconds in this setting then the call is discarded. The default value of '0' accepts all calls. This feature is valid in CDR configurations only.

SET EXT->EXT - This command accepts either a 'Yes' or 'No' argument. If set to 'Yes' then calls with an Originating ID Type of 'D' and a Terminating ID Type of 'D' which makes them internal calls, will be retained. If 'No' then these calls will be discarded. The volume of calls retained could increase dramatically if this setting is 'Yes' so caution should be used to ensure that the MDR-2000 has sufficient capacity to handle the volume. The default setting is 'No'.

SET HELP - This option causes a list of the SET options to be output.

SET IDLE - SET IDLE PBX <Value> - Sets an alarm interval which monitors PBX activity. If the interval elapses with no output from the PBX then a single carriage-return character (ASCII 0DH) is output to the PBX and the response monitored. If there is no response after 2 seconds then an M2KIDL error message is annunciated. The SET ALARM command must be used to enable alarm annunciation. The range is between 0 and 59 minutes, the default is 0 which indicates the feature is disabled.

SET IMAGE - This option accepts either a 'Yes' or 'No' argument. If 'Yes' then the data rejected by the selective CDR processing routines is stored in its image form, otherwise this data is rejected.

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When SET IMAGE is set to 'Yes' SET CDR is automatically set to 'No'. Therefore make sure that if both types of data are desired that SET CDR is set to 'Yes' after using the SET IMAGE command. Note that if both SET IMAGE is 'No' and SET CDR is 'No' data will not be retained by the MDR-2000. The default setting is 'No'.

SET INCOMING - This option allows the user to specify whether or not incoming calls are to be retained or ignored. Note that with some PBXs the digits dialed field is used to determine if this is an incoming call, and in others the originating ID is used. The default setting is 'Yes'.

SET METER - This option accepts either a 'Yes' or 'No' as an argument. If yes then the meter pulse field on the PBX will be scanned for a valid entry which will be placed in the Meter Pulse field of the output record. If 'No' then this field will be ignored but the output Expanded MDR Standard Format record will contain a zero value in this field.

This setting is only useful if the PBX generic supports the meter pulse capability which is normally encountered only in areas outside North America. The default setting is 'No'.

SET MULTI - This option accepts either a 'Yes' or 'No' as an argument. If 'Yes' then the Customer Number field will reflect the tenant using the PBX who placed the call. Note that this field is only applicable in multi-tenant PBX configurations which support a customer number field. The default setting is 'No'.

SET NAME - This option allows the user to specify a name for the unit. The name has no significance except that it is easier to identify the unit with a name than a serial number. The name can be up to 20 characters long. To delete the name completely use either the <Tab> key or simply enter a single space which has the same effect.

SET OPTIONS - This command accepts a string of characters used to specify certain MDR-2000 feature settings. As of this release the string is three characters in length and are defined as follows:

1. The first character can be either a 'Y' or an 'N'. If 'Y' then the MDR-2000 assumes that the current year is a leapyear. This feature applies only to those PBXs that utilize a Julian date. The default is 'N'.
2. The second field can be either a 'F' or an 'L'. If it is an 'F' then the original extension responsible for the transfer of a call will be credited with the call, if it is an 'L' then the last extension to handle the call will get credit for the call. This feature is only applicable on a PBX where the MDR-2000 processes transferred calls (i.e. Meridian 1). The default setting is 'L'.
3. The third character can be either a 'Y' or an 'N'. If 'N' then the MDR-2000 date and time are updated by valid call records or date records. If 'Y' then the MDR-2000 keeps track of

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the date and time from its own internal clock. This feature is used on PBX generics where the date and time are not available on each call record. The default setting is 'N'.

Note that the string is processed in such a way that any erroneous values entered result in the default action being applied. Also note that pressing the <Tab> key will cause the default string to be restored. The default setting is 'NLN'.

SET PARITY - This option accepts two values which specify the parity to be used on the PBX port and the modem port respectively. The parity settings that may be selected are 'N', 'E' or 'O' for None, Even or Odd parity respectively. The default setting is 'N'.

After entering the PBX parity the <Enter> key must be pressed for the modem parity prompt.

SET PORT RESET- This option sets a timeout interval for the RS-232 ports. If the time specified elapses with no activity on any port then the ports are internally reset by reprogramming the uarts. The range is between 0 and 59 minutes, the default is 15. Use 0 to disable the option.

SET PRIMARY PHONE - This option accepts a phone number for use when the MDR-2000 must call the host computer. The phone number must conform to the Hayes Smartmodem 1200 protocol and may contain digit control characters allow by the Hayes autodialer. The phone number may be up to 25 characters long.

The Primary Phone Number is dialed first followed by the Secondary Phone Number. If the Primary Phone Number is empty then a direct connection is assumed. To delete the entry use the <Tab> key.

SET RETRIES - This option sets the number of autodialer retries when attempting to annunciate an alarm condition. When this number of unsuccessful attempts has been completed the alarm condition is disregarded. The range is between 0 and 255, the default is 5.

SET SECONDARY PHONE - This option accepts a phone number for use when the MDR-2000 must call the host computer. The phone number must conform to the Hayes Smartmodem 1200 protocol and may contain digit control characters allow by the Hayes autodialer. The phone number may be up to 25 characters long.

The Secondary Phone Number is dialed after the Primary Phone Number. If the Secondary Phone Number is empty then no connection is assumed and alarm message will not be sent a second time. To delete the entry use the <Tab> key. Entering a space as the new phone number will not work since the MDR-2000 would detect this as a legitimate string and attempt to send the message twice.

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SET SITE - This option allows a site number to be specified for the unit. The number is intended for use with alarm applications which may elect to poll the unit after communications has been established by the MDR-2000. When the alarm annunciation occurs the site number is the means to determine in which data files to store the collected information. Site numbers are used by the telemanagement applications to distinguish data between PBX's. The number can be up to 2 characters long.

SET TANDEM - This option accepts either a 'Yes' or 'No' as an argument. If 'Yes' then the ID Type on the Originating ID will be converted from a 'T' to a 'D' on tandem calls. Tandem calls are defined as those calls which have an ID Type of 'T' for both the Originating ID and Terminating ID fields. The default setting is 'No'.

SET THRESHOLD - This option accepts a decimal value which is used to determine when the MDR-2000 should raise a 'Buffer Full Alarm'. When the number of records in the unit reaches the value then the MDR-2000 will initiate a call using the digits entered in the SET PRIMARY PHONE and SET SECONDARY PHONE commands. The default setting is '0'.

This alarm has the same format as PBX or external device generated alarms. The alarm code is 'M2KTHR:' with a message of 'Storage Threshold Exceeded'. See the section on Alarm Annunciation for more details on alarm messages.

SET TIME - This option accepts the date in the form 'hhmm'. The time is used by the MDR-2000 in maintenance alarm messages.

SET XFER BLOCK - Sets the number of records to be transmitted in a block in response to the 'XB' command. The block size may be set from 1 to 255 records, the default is 1.

5.2.2 Show Command Details

The SHOW command provides for a number of options each specifying different information to be displayed. This section deals with each of these options and the way they are implemented by the Interactive Monitor.

The following paragraphs deal with each of the SHOW command options.

SHOW ALARM - Displays the contents of the Alarm Table. The entries of the Alarm Table which is setup by the ALARM TABLE command are output one per line on the user's display. Note that empty entries will not be displayed. Also, since no scrolling is provided the display may run off the top of the screen. In this case using a terminal emulation program to capture the table is a suitable alternative.

SHOW AUTODIAL - Lists information used by the autodialer including retry thresholds and the user programmable telephone numbers. The retry thresholds are for information purposes only, there are no commands to alter these settings. The telephone numbers can be modified by using the SET PRIMARY PHONE and SET SECONDARY PHONE commands.

SHOW DIGITS - Displays the contents of the Digits Table. The entries of the Digits Table which is setup by the DIGITS TABLE command are output one per line on the user's display. Note that empty entries will not be displayed. Also, since no scrolling is provided the display may run off the top of the screen. In this case using a terminal emulation program to capture the table is a suitable alternative.

SHOW HELP - Provides a list of the SHOW command keywords to be displayed.

SHOW IDENT - Displays data identifying the MDR-2000 software including PBX generic supported, software revision, serial number, copyright notice, site number and site name. This command is an expanded version of the ^VID command. The site number and site name are blank by default. These values can be set by using the SET SITE and SET NAME commands respectively.

SHOW MAINT - Displays maintenance data for diagnostic purposes. It is identical to the ^VSM command except that no transmission protocol is used. Each of the fields is described in section 6.2 'Remote Examination'.

SHOW PORT - Displays the RS-232, Transfer Blocksize and Discrete Mode settings. On the first line the PBX port is output first followed by the modem port settings. The settings are output as

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Baud rate, followed by byte size and then parity. These values can be set with the SET BAUD, SET BYTE SIZE and SET PARITY commands.

The successive lines display the Transfer Blocksize and Descrete Mode settings. These can be set with the SET XFER BLOCK and SET DESCRETE COLLECTION FUNCTIONS commands. The default settings are shown in the example below:

```
PBX/Modem: 1200-8-N/ 9600-8-N
Transfer Blocksize: 1
Descrete Mode: No
```

SHOW STATUS - This command is identical to the STATUS command described earlier.

5.2.3 Customize Command Details

The Customize command is used to specify PBX specific information to the MDR-2000. This information describes the format of the input data from the specific PBX. The Customize command accepts a single string as an argument. When invoked it outputs any existing string that may have been previously programmed into it. On certain PBXs a string may have already been programmed as a default. This is done by those PBXs automatically when they detect that no string exists.

When issued the Customize command will display a list of the preprogrammed choices. The format of the lines correspond the string formats described below. The choices are followed by the default Customize string for this PBX, followed by a prompt for user input.

If one of the preprogrammed choices is desired then it may be selected by entering the corresponding number of the choice prefixed by a '#'. For example, preprogrammed choice '2' would be entered as '#2'.

When entering a replacement string the entire string must be typed. Usually this will be a modification from line 1 (default string) or line 2 of the Customize output. To delete a string, and revert back to the default string enter the <Tab> key, to leave the string unchanged simply press the <Enter> key. To abort the command with a partially entered string enter <Ctrl-C>. The <Delete>, <Bksp> and other special keys are not functional with this command.

The format of the string, and the meaning of its content, varies depending on the PBX. MDR service personnel can assist you if changes to the string are required. However, in situations where alternate programming of the string are required the following guidelines can be used:

1
10,18,0,26,32,41,20,3,(47)53,53,53,0,0,3,0,7,0
5-16
1
2 267719
41 42 43 44 45 46 47 48 49 50 51 52 53

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- o A string beginning with a '\$' symbol indicates that this string represents the locations of the various fields in the PBX input record. The format of the string then is:

\$val1,val2,val3,...,valn

Where the values 'val1' through 'valn' are as follows:

Position	Field	Description	
val1	Orgid	Originating trunk or station of the call.	10
val2	Terid	Terminating trunk or station of the call.	18
val3	Auxid	Auxiliary ID.	0
val4	Date	Date of the call.	26
val5	Time	Time of the call.	32
val6	Duration	Duration of the call.	41
val7	Meter	Number of meter pulses used during the call.	20
val8	Ring	Ring time to answer the call.	3
val9	Access	Access code.	47
val10	Digits	Digits dialed.	53
val11	Account	Account code.	53
val12	Authorization	Authorization code.	53
val13	Transfer	Transferred trunk or station.	0
val14	Code	Condition code.	0
val15	CLID	Calling line ID (Incoming digits dialed).	3
val16	Misc 1	PBX specific field.	0
val17	Misc 2	PBX specific field.	7
val18	Misc 3	PBX specific field.	0

- o If any values are specified, then all values MUST be specified. The first position in a data record is referred to as column 1. If the last value entered in non-zero then an additional zero value field must be entered.
- o If a value is not applicable to this PBX then a value must be entered, usually zero.
- o The '\$' is a flag to the MDR-2000 that this data reflects the column positions of fields in the incoming record. Alternate flags may be defined on a PBX specific basis.

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- o The '#' is a flag to the MDR-2000 that this data is a direct command to the PBX specific module to load a predefined set of column definitions. Note that if the input does not begin with either a '\$' or '#' then the input will be considered invalid and '#1' will be used.
- o If errors are detected in the Customize string then the default values will be used.

This feature is very technical but it does allow some measure of flexibility to cope with manufacturer's changes in CDR output from the PBX. It is suggested the Customize command only be used under direction of MDR or its dealer service representatives.

5.2.4 Digits Table Command Details

The 'DIGITS TABLE' command allows the user to enter up to 20 strings of characters that are scanned by the CDR processing configuration of the MDR-2000. Each entry can be up to 8 characters in length. Each string is composed of any valid ASCII characters except those used to control the table entry process such as <Control-C>, <Delete>, and <Control-V>.

When the command is invoked the first entry in the table will be displayed followed by a '-->' as in the following example:

```
M2K>Digits Table (Return)
(RET - Leave entry unchanged, TAB - Remove entry, Ctrl-C - Exit command)

9411    -->
```

The current value of the first entry is '9411' and this may be changed by entering the new value and pressing <Enter>. To delete the value the user presses the <Tab> key. To leave the entry at its current value the user simply presses <Enter> at which point the value of the next table entry will be displayed.

To exit from the 'DIGITS TABLE' command <Control-C> can be entered, or the <Enter> key can be pressed until the table is exhausted. The table can be output by using the SHOW DIGITS command.

5.2.5 Alarm Table Command Details

The 'ALARM TABLE' command allows the user to enter up to 25 strings of characters that are scanned by the image processing configuration of the MDR-2000. Refer to the section on Alarm Annunciation for more details on alarm processing.

Each entry can be up to 14 characters in length followed by a repeat count of up to 2 digits preceded by a '.' delimiter as shown in the example below. Each string is composed of any valid ASCII characters except those used to control the table entry process such as <Control-C>, <Delete>, and <Control-V>.

When the command is invoked the first entry in the table will be displayed followed by a '-->' as in the following example:

```
M2K>Alarm Table (Enter)
(RET - Leave entry unchanged, TAB - Remove entry, Ctrl-C - Exit command)
```

```
B0001.1  -->
```

The current value of the first entry is 'B0001' followed by a repeat count of '.1'. This may be changed by entering the new value and pressing <Enter>. To delete the value the user presses the <Tab> key. To leave the entry at its current value the user simply presses <Enter> at which point the value of the next table entry will be displayed.

If a repeat count is not provided then a default of '.1' is inserted by the MDR-2000 automatically.

To exit from the 'ALARM TABLE' command <Control-C> can be entered, or the <Enter> key can be pressed until the table is exhausted.

Alarm table entries are not case sensitive. In fact lowercase characters are converted to uppercase when entries to the table are made, and any characters from the input stream being checked for valid alarm conditions are also converted to uppercase.

The table can be output by using the SHOW ALARM command.

5.2.6 Test Command Details

TEST HELP - This option causes a list of the TEST options to be output.

TEST LOGICAL - This test is intended to detect RAM errors that are more difficult to detect. It is a more exhaustive RAM test on the MDR-2000. The records stored in the buffer RAM have their checksums recalculated and compared with those calculated when the record was stored. This is a more exhaustive test but since it is a logical test it will only examine those memory locations that have stored, but as of yet uncollected, data.

If the MDR-2000 buffer is empty then this test will always complete successfully, if the buffer is full then this test is most effective.

For convenience the LEDs will display the progress of the test. The display corresponds to the ones complement of the record count remaining to be checked, divided by 256. It is provided as an indicator that the test is progressing since with large buffers filled to near capacity the test will take a several minutes to complete.

TEST NVR - This test performs a checksum test on the non-volatile RAM.

TEST PORT - This test dumps a continuous test pattern over the modem port. It is used to test the port or host interface. The test is terminated by entering <Control-C>.

TEST RAM - This test performs a simple read and write test on the processor memory. This is a non-destructive memory test and as such is not exhaustive. Therefore it is only conclusive when hard memory errors occur. This test can be interrupted by pressing <Control-C>.

5.3 Messages

The Interactive Monitor will output messages whenever an error or other notable activity has occurred. These messages are as follows:

Canceled - This message indicates that a command has been aborted by typing <Control-C> or pressing the Delete key.

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Data Collection Suspended During Test - This message indicates that data collection has been halted temporarily while this command executes.

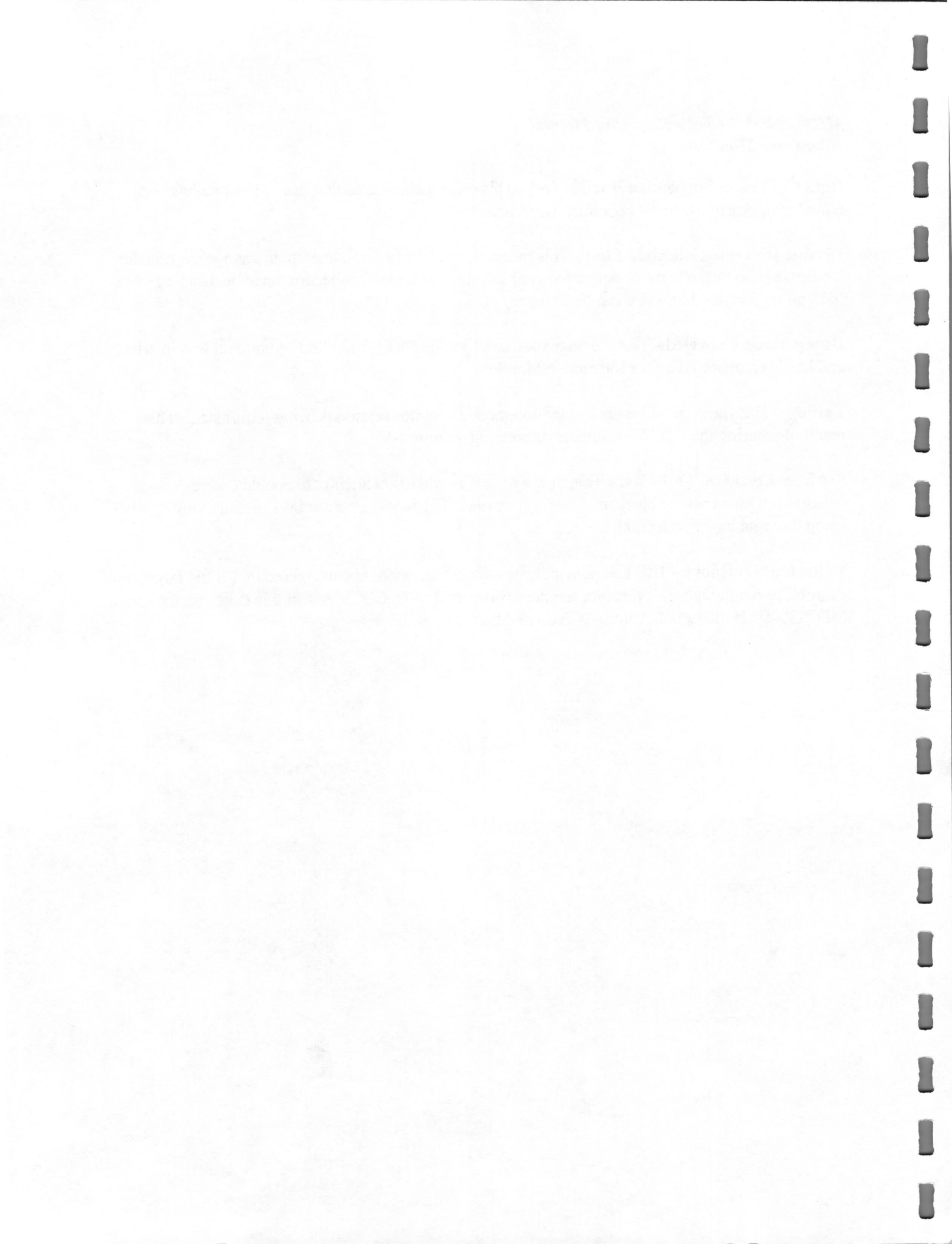
Disable Descrete Collection First - This message results when you attempt to change the transfer blocksize with descrete mode collection enabled. Descrete mode collection must be disabled (default) before the blocksize can be changed.

Dump Mode Canceled - This message indicates that the MDR-2000 'SD' command was in effect and has been canceled by the Interactive Monitor.

Exiting - This message indicates that the Interactive Monitor session is being terminated. This is a result of entering the 'EXIT' command or pressing <Control-V>.

Set Xfer Blocksize To 1 First - This message results when you attempt to enable descrete mode collection with a transfer blocksize greater than one. The blocksize must be 1 (default value), when using descrete mode collection.

Value Out Of Range - This message indicates that a number has been entered that is too large. For example, even though the processor memory can access up to 64K less than this exists on the actual MDR-2000. If the actual quantity is exceeded then this message results.



Chapter 6

TROUBLESHOOTING

The purpose of this section is to review the various operational characteristics of the MDR-2000 to assist in troubleshooting the more common problems. The MDR-2000 is a comprehensive device designed for optimal Call Detail Recording storage and pre-processing of records. The units have a proven track record of reliable operation but sometimes things do go wrong.

Problems are generally in one of four functional components; the PBX itself, cables, modems and transmission equipment or the MDR-2000. The intrinsic diagnostic capabilities of the MDR-2000 make diagnosis of the problem straightforward.

6.1 Preliminary Considerations

When troubleshooting MDR-2000 problems it is important to review the nature of the device and its role in the data collection process.

The MDR-2000 is typically used as a 'slave' device. In this role it performs the following:

- Captures data sent to it from the PBX but does not send any communications to the PBX
- Pre-processes CDR data and stores it for later retrieval. Image (or non-CDR data) can be optionally stored, but no processing is performed.
- Responds to commands from the downstream data collection processor by sending these preprocessed records. It does not initiate communications and only responds when prompted by specific commands.

The key to understanding the role the MDR-2000 plays is that it does not usually initiate communications with the outside world (except in its role as an Alarm Annunciator).

Further, the communications ports do not use any flow control or hardware signaling. Therefore external communications devices such as modems and multiplexors must be configured not to expect control signals from the MDR-2000. In addition, these devices must be data transparent. Modems or multiplexors that respond to 'XON/OFF' or 'ACK/NAK' type protocols may erroneously detect such signals. This is because the MDR-2000 uses checksums and byte counts in

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its protocol with the downstream processing facility which may inadvertently have these character values.

With this background, if communications with the PBX is problematic or there are difficulties downloading data the following should be reviewed:

- Make sure a cable connections are secure, and that the cables are the correct type. The cable from the MDR-2000 to the PC must be a 'direct' cable, the cable from the MDR-2000 to a modem must be a 'null modem' cable (the null modem cable is usually provided).
- Make sure PBX is generating output. Often the cable to the PBX is not installed correctly or the serial port on the PBX is disabled.
- Make sure communications port settings are correct. The default in the MDR-2000 is 1200 Baud, 8 data bits, no parity.
- Make sure communications link with downstream processing facility is data transparent. Disable any flow control or handshaking that might be in place.
- If the MDR-2000 is responding to commands from a terminal program, but is not collecting data from the PBX, use the 'DU' command which will cause any data received from the PBX to be dumped, unedited, on the terminal. This will confirm that the data flow is setup correctly, and the problem is a record formatting problem.

6.2 Physical Examination

When examining the MDR-2000 physically the first step is to ensure that all cables and power cords are properly secured.

On the modem the terminal ready indicator and the modem clear indicator should be on. On the MDR-2000 itself, LED RUN (CR9) should be on. If it is not, and no other LED's are on, then the MDR-2000 is totally inoperable. Check to ensure that power has been applied to the MDR-2000.

If LED RUN is on, and LED BMT (CR6) is on then the unit is operating and there are no call records stored in the unit. When LED BMT is extinguished the unit is properly collecting calls. On new installations it is sometimes a problem to get proper call recording established due to variances in the PBX record format. LED BMT is the key to determining when the problem is resolved.

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If LED BMT is not extinguished check the PBX transmitter LED which is labeled PBX (CR5). It should flicker as data is transmitted from the PBX to the MDR-2000. In addition, INT (CR8) and RUN (CR9) will also flicker, as the data is transmitted. If LED PBX is being activated then the PBX is sending data to the MDR-2000 but the MDR-2000 is rejecting the data. Check the PBX port Baud rate to ensure that its setting matches that of the PBX.

If the Baud rates are correct it is necessary to check that the correct generic of MDR-2000 ROM is installed or that the PBXs CDR option is correctly programmed.

If the above analysis indicates that the ROM may be the problem then a terminal must be used to evaluate the performance of the ROM. This will reveal clues to the source of the problem, and will be discussed in the following section under Remote Examination.

Failure of the unit to collect data or the LED's to indicate any data capture activity may result from cable or serial I/O port problems, including incorrect Baud rate, parity or byte size settings.

LED ERR (CR4) is the MDR-2000 hardware error indicator. It will be permanently on if an unexpected hardware problem has occurred, or if during transmission of data to the host a memory error has been detected. Generally this indicator is a warning that the hardware has malfunctioned. However, unless it is accompanied by some of the other problems discussed in this section, it can be ignored until preventative maintenance is convenient. CR4 is reset by the 'SM' command.

Finally, a brief note on LED's INT and RUN. LED RUN is illuminated when the MDR-2000 is not handling input or output over its communications ports. INT is illuminated when there is a hardware interrupt in progress. Hardware interrupts occur when there is activity over the input or output ports. In general when INT is illuminated, RUN will not be, and visa versa. If INT is constantly on then the MDR-2000 is being inundated with interrupt requests, this is not the normal mode of operation.

6.3 Interactive Examination

To perform an interactive examination dial the MDR-2000 or connect a terminal directly to a local MDR-2000 or via modem. Access the Interactive Monitor by entering the following sequence on the terminal; ^VIM<Enter>.

Use the Ident command to confirm the name of the PBX generic supported by the ROM to ensure that this is in fact the correct MDR-2000 ROM for this PBX. The is sample output from an Ident command:

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MDR-2000 Plus
Meridian 1 Generic
Rev. 3.S34.G41
Ser. 003423
Copyright (c) 1999 MDR Technologies Inc.

The revision level consists of three parts, the major revision number, specific edit level and general edit level. By comparing these edit levels of the installed MDR-2000 to those of the latest revisions available from MDR Technologies it can be quickly ascertained as to whether the problems being encountered are due to the missing edits. If so then a new ROM must be installed with the latest revisions.

Use the Status command to determine if any records are stored in the unit, the communications port settings and the data collection/filtering settings. An example of the Status command output is shown below:

Date/Time (mm/dd hh:mm): 01/01 00:01	Option Settings: NLN
Number of Records Stored: 0	Records to be Collected: 0
Port Config (PBX/Modem): 1200-8-N/ 1200-8-N	Minimum Duration: 0
Incoming Calls: Yes	Minimum Digits: 0
CDR Collection: Yes	Image Collection: No
Meter Pulse Detection: No	Multi Tenant Detection: No
Tandem Conversion Option: No	Internal Calls (Ext->Ext): No
Last Scan Error Position: 0	Alarm Threshold: 0
Port Reset Timer: 15	Idle PBX Alarm Threshold: 0
Logical Error Count: 0	Alarm Enabled: No
Buffer Memory Size: 128K	I/O Interrupt Status: Clear
Site Name:	Site #:
Primary Alarm Phone No:	
Secondary Alarm Phone No:	

The 'Number of Records Stored' indicates the total number of records retained by the MDR-2000. The 'Records to be Collected' field specifies how many of those records have been collected. Typically when data collection is completed both values will be zero and begin incrementing as records are received from the PBX. If the values are different it likely indicates that the downstream data collection process was aborted for some reason. The computer-to-computer command 'CL' will erase the collected records so that both values will be the same.

The Logical Error Count setting indicates that memory parity errors were detected when certain records were prepared for transmission to the downstream data collection system. This is not a transmission problem but rather an MDR-2000 memory problem.

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Check all of the settings that control the filtering of the data to ensure that records are not being inadvertently being discarded. For example, if 'Minimum Digits' is set to 15 then virtually all of the calls may be discarded. The fields to check are:

Minimum Duration
Minimum Digits
CDR Collection
Image Collection

Use the Customize command to list the preprogrammed settings and the selection or custom string which is being used. An example is shown below:

Choices Are:

```
#1 --> 10,18,0,38,44,50,26,0,0,59,0,0,0,0,56,12,7,0
#2 --> 10,19,0,28,34,40,0,0,0,49,0,0,0,0,0
#3 --> 10,18,0,36,42,48,0,0,0,57,0,0,0,0,0
#4 --> 10,18,0,26,32,38,0,0,0,47,0,0,0,0,0
#5 --> 10,17,0,31,37,43,0,0,0,52,0,0,0,0,0
#6 --> 10,17,0,24,30,36,0,0,0,45,0,0,0,0,0
#7 --> 10,19,0,35,41,47,0,0,0,56,0,0,0,0,0
#8 --> 10,18,0,38,44,50,26,0,0,59,0,0,0,0,0,12,7,0
#9 --> 10,18,0,38,44,50,26,0,0,59,0,0,0,0,2,12,7,0
Cur> #1
New>
```

Refer to the section on the Customize command to make sure that the format of the CDR data from the PBX closely matches that as defined by the Customize string. In general, Customize #1 matches the CDR data most commonly encountered for each PBX generic.

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The next command which can be used to verify the operation of the MDR-2000 is the maintenance command which is invoked by entering the Show Maint command. This command outputs information which resembles the following:

```
000001 000001 000001 Rev. 3.S34.G41 003423 05 00 01 00 256
```

There are 10 individual fields displayed by the maintenance command each of which is described below:

Field #	Example	Description
1	000001	Next free address in the buffer memory. The next record received from the PBX will be stored beginning at this location.
2	000001	The next full address in the buffer memory. If this value is equal to the next free address then the MDR-2000 is empty.
3	000001	The current address in the buffer memory. This is the location advanced to with the 'OK' command.
4	Rev. 3.S34.G41	The software revision currently installed.
5	003423	The hardware serial number uniquely identifying this MDR-2000.
6	05	This is value of the LED's at the moment the Show Maint command is executed. The value of ERR can be determined from this output.
7	00	This is a decimal value which indicates the character position (beginning with 1) where records are being discarded due to format non-conformance.
8	01	This is a hexadecimal value indicating the number of unexpected interrupts at vector 38H. These are generally I/O interrupts. This value is cleared by the 'SM' or Show Maint commands.
9	00	This is a hexadecimal value indicating the selection of the 'Set Descrete Collection Functions' command. '00' indicates that it is disabled, 'FF' indicates that Descrete Mode is on.
10	256	This is a decimal value indicating the buffer memory capacity in 'K'. This example indicates a 256K buffer.

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The information provided by the Maintenance command should correspond exactly with that of the Interactive Monitor. If data has been stored, but is no longer being recorded, and the first three values are '000001' then the unit has been reset. Resets are typical of a catastrophic hardware or software malfunction that might result from a sudden electrical discharge. Sources of these are power surges and static discharge. Temporarily turning the unit off will also cause a reset as will the operator-to-operator 'MR' command.

Run the various onboard diagnostics available on the MDR-2000. These will detect solid hardware malfunctions, but are unlikely to detect intermittent faults. Refer to the section of the Test commands for details.

6.4 Reporting A Problem

When reporting a problem to MDR or your service representative it is important to have adequate information available. Following information is required if an accurate and timely problem resolution is to be achieved:

- EPROM revision information from the Interactive Monitor's Ident command.
- Status information from the Interactive Monitor's Status command.
- The external serial number which is found on the rear of the unit.
- The model of the PBX being monitored and the generic of software in use. Include any software settings that affect the CDR output of the PBX.
- Output from the Customize command showing the individual field settings or the customize string selection.
- A sample of CDR output from the PBX on diskette. This is extremely important in diagnosing obscure problems since PBX output may vary from the published specifications. If not available on diskette then hardcopy output is acceptable.
- Results from the MDR-2000 Test commands; Test NVR and Test Ram.
- Details on the modems, multiplexors or other transmission equipment being used. Include model numbers, speeds and any special or unusual features that are being used.

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- The version and model of downstream processing software being used for polling (i.e. MDR-5000).
- Provide your name, company, telephone number and fax number so that you can be contacted if additional information is required.

Chapter 7

HARDWARE

The purpose of this section is to describe the functional components of the MDR-2000 hardware. As well a description of the cable requirements is provided.

7.1 Hardware Overview

The MDR-2000 is a Z80 CPU based system with 64K bytes of processor memory (RAM) and 128K to 8MB of buffer memory. There are two RS232-C serial ports each capable of transmitting and receiving at speeds from 300 Baud to 19200 Baud.

In addition, there is provision for a 128K-bit ROM, which overlays the first 16K of processor memory.

Clock interrupts are available on the MDR-2000 and are used to drive certain housekeeping routines such as the internal timestamp and interval timers. Output is driven on a polled basis, and input is interrupt driven through vector 38H.

An additional keepalive circuit is provided which generates an interrupt at vector 66H if it is not reset by the software. In the event of a hardware or software malfunction this feature would assure that the MDR-2000 was restarted automatically. The reset is performed by directing a single byte of output to the appropriate I/O address.

The MDR-2000 requires a single 110VAC outlet to supply its internal power supply. This power supply is used to provide the requirements for the MDR-2000 as well as keep its battery backup fully charged. In the event of a power disruption, the MDR-2000 has sufficient battery capacity for about 60 minutes of operation.

The unit is housed in a single cabinet and requires no cooling fans or external climate except for that found in the normal office or communications room environment.

7.2 Cables

The MDR-2000 is designed to connect directly to a PBX through use of the MDR-2000 PBX port, and directly to a modem using the MDR-2000 modem port. For this reason the PBX port is wired as a serial terminal (DTE) and the modem port as a modem (DCE). The following paragraphs describe the cabling required for the two ports under different circumstances.

The cable from the PBX to the MDR-2000 is provided by the local telephone equipment supplier. The connector made available for use on the MDR-2000 must be a male DB25-P EIA connector with pins labeled 1 through 25. This is the most commonly used connector configuration for EIA RS232-C interfaces.

The connector pins must be wired as follows:

Pin	Description
1	Protective ground.
2	Transmitted data from MDR-2000.
3	Received data from PBX
4	Request to send (RTS).
5	Clear to send (CTS).
6	Data set ready (DSR).
7	Signal ground.
20	Data terminal ready (DTR).

Any pins not designated should not be used. The cable can be inserted directly into the female PBX port on the MDR-2000.

The MDR-2000 modem port must be connected either to the host computer system or a modem. The cable provided with the MDR-2000 is a null modem configuration which is used for the modem to MDR-2000 connection.

The cable supplied has DB25-P connectors at each end. The correspondence between pins at each end is listed in the table below:

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DB25 Pin	DB25 Pin
1	1
2	3
3	2
4	6
5	20
6	4
7	7
20	5

A straight cable (customer provided) must be used when connecting the MDR-2000 directly to a host system. In this case the 8 pins listed above would have a one-to-one correspondence.

On some computer systems the communications port will have a 9 pin connector (DB9) instead of the 25 pin connector (DB25). In these cases the wiring of the cable must conform to the following table:

DB9 Pin	DB25 Pin
1	8
2	3
3	2
4	20
5	7
6	6
7	4
8	5
9	22

Cable length depends on the type of cable used and on the environment through which the cable is placed. In electromagnetically noisy areas, such as factory floors and elevator shafts, cables of shorter length must be used. With longer cables the quality of the transmission deteriorates and the information sent is sometimes made corrupt by the external noise.

Generally the MDR-2000 will be located in the equipment room or next to the host computer system or modem. Therefore only one of the two connecting cables need be longer than a few feet. The maximum cable length specified by the RS232-C standard is 50 feet, however experience has

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shown that the following table specifies the actual practical length of cable that can be used for various Baud rates:

Baud Rate	Shielded (Feet)
300	5000
1200	3000
2400	1000
4800	1000
9600	250

The shielded cable used in the above table is 22 AWG twisted pairs each with overall shield equivalent. Note that information was not available on the maximum distance for 19200 Baud communications.

Appendix A

ASCII Equivalents

Dec.	Hex.	ASCII	Dec.	Hex.	ASCII
000	00	NUL	032	20	Space
001	01	SOH	033	21	!
002	02	STX	034	22	"
003	03	ETX	035	23	#
004	04	EOT	036	24	\$
005	05	ENQ	037	25	%
006	06	ACK	038	26	&
007	07	BEL	039	27	'
008	08	BS	040	28	(
009	09	HT	041	29	)
010	0A	LF	042	2A	*
011	0B	VT	043	2B	+
012	0C	FF	044	2C	,
013	0D	CR	045	2D	-
014	0E	SO	046	2E	.
015	0F	SI	047	2F	/
016	10	DLE	048	30	0
017	11	DC1	049	31	1
018	12	DC2	050	32	2
019	13	DC3	051	33	3
020	14	DC4	052	34	4
021	15	NAK	053	35	5
022	16	SYN	054	36	6
023	17	ETB	055	37	7
024	18	CAN	056	38	8
025	19	EM	057	39	9
026	1A	SUB	058	3A	:
027	1B	ESC	059	3B	;
028	1C	FS	060	3C	<
029	1D	GS	061	3D	=
030	1E	RS	062	3E	>
031	1F	US	063	3F	?

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Dec.	Hex.	ASCII	Dec.	Hex.	ASCII
064	40	@	096	60	`
065	41	A	097	61	a
066	42	B	098	62	b
067	43	C	099	63	c
068	44	D	100	64	d
069	45	E	101	65	e
070	46	F	102	66	f
071	47	G	103	67	g
072	48	H	104	68	h
073	49	I	105	69	i
074	4A	J	106	6A	j
075	4B	K	107	6B	k
076	4C	L	108	6C	l
077	4D	M	109	6D	m
078	4E	N	110	6E	n
079	4F	O	111	6F	o
080	50	P	112	70	p
081	51	Q	113	71	q
082	52	R	114	72	r
083	53	S	115	73	s
084	54	T	116	74	t
085	55	U	117	75	u
086	56	V	118	76	v
087	57	W	119	77	w
088	58	X	120	78	x
089	59	Y	121	79	y
090	5A	Z	122	7A	z
091	5B	[	123	7B	{
092	5C	\	124	7C	
093	5D	]	125	7D	}
094	5E	^	126	7E	~
095	5F	_	127	7F	DEL

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Appendix B

User Notes

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